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Annual Report 1986

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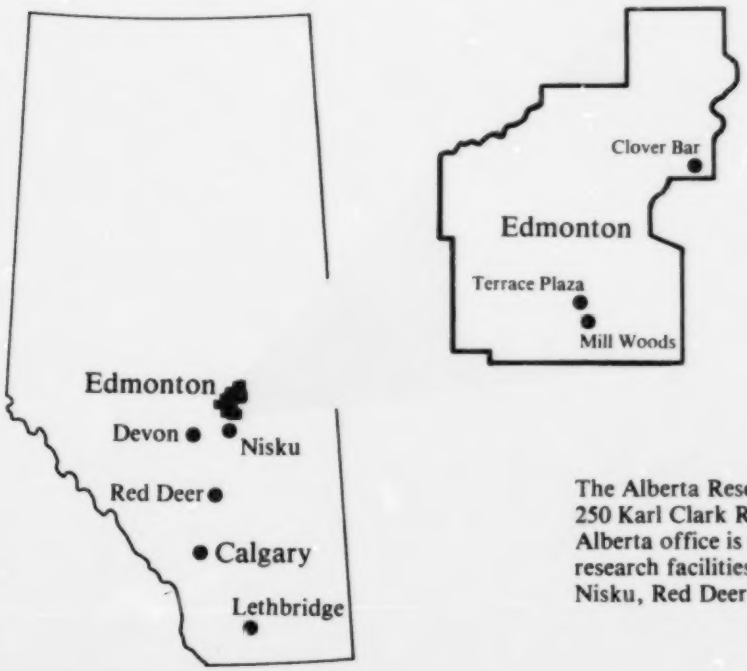


The Alberta Research Council's head offices are located at 250 Karl Clark Road in south Edmonton and the southern Alberta office is 6815 - 8 Street NE, Calgary. Offices and research facilities are located in Edmonton, Calgary, Devon, Nisku, Red Deer and Lethbridge.

Alberta Research Council Annual Report 1986

To advance the economy of the province by promoting technology development, performing applied research, and providing expert advice, technical information and scientific infrastructure that is responsive to the needs of the private sector and supports activities of the public sector.
- *Mission Statement of the Alberta Research Council*

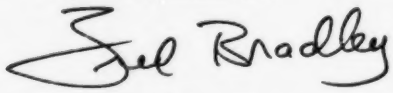
ALBERTA
RESEARCH
COUNCIL

Letter of Transmittal

To The Honorable Don Getty
Premier of the Province of Alberta

In accordance with the requirements of the Alberta Research Council Act, I have the honor to present to you the Annual Report of the Alberta Research Council for the calendar year 1986.

Respectfully submitted,



Fred D. Bradley, M.L.A.
Chairman of the Board
Alberta Research Council

March 1987

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Cover

Cutaway of this prototype wall structure shows waveboard which could replace conventional frame construction. The technology for producing waveboard was developed in the Alberta Research Council's Forest Products laboratory.

Photo: L. Lorinczi

Corporate Profile

The Alberta Research Council is a crown corporation of the Province of Alberta, offering a diversified range of scientific, engineering and technological research and testing capabilities. The seven major research programs are:

Oil Sands Research: Bitumen recovery processes by steam and/or additive injection in the Athabasca and Cold Lake oil sands; geological and hydrogeological investigations at Athabasca, Cold Lake and Peace River; numerical modelling; maintenance of an oil sands sample bank to supply international laboratories.

Energy Processing: Coal conversion research including agglomeration in stirred tanks; liquefaction, hydrocarbon upgrading; coal geology; classification and evaluation of Alberta coals by pyrolysis and petrography.

Natural Resources: Geological studies and mapping; terrain sciences, concentrating on management of soil and water resources; land reclamation for use after surface mining; mathematical modelling of fluid flow in deep sedimentary basins; storm behavior and hail formation.

Biotechnology: Microbiology, fermentation technology and pilot scale-up, plant cell culture and crop improvement for cold hardiness, genetic engineering in the development of pharmaceuticals.

Industrial Technologies: Research and testing laboratories for forest products, gasoline and oil, materials and industrial chemicals.

Advanced Technologies: Computer-based and automation technologies for application and transfer to industry.

Service to Industry: Providing short-term advisory and technical service to Alberta companies. Administration of the National Research Council's Industrial Research Assistance Program (IRAP) funds for Alberta industry.

The Alberta Research Council operates five specialized information centres in industrial information, electronic industry information, oil sands, geology and waste exchange.

The Electronics Test Centre, which is sponsored by the Alberta Research Council, provides testing and evaluation services to electronic and telecommunications products manufacturers requiring product certification, and provides companies with engineering assistance in planning and developing new products.

Chairman's Message

It is with great enthusiasm that I accepted the appointment earlier this year as Chairman of the Board of Directors of the Alberta Research Council. It gives me the opportunity to be associated with an organization that has played such a large part in the development of the Province of Alberta.

Founded in 1921, the Research Council is not only the oldest provincial research organization, it is one of the largest research laboratories in Canada. With the official opening on September 30 of the new $65 million research laboratories and headquarters, Alberta has a world class research and testing facility. The substantial organization that the Alberta Research Council is today owes much to the men and women of vision who have believed in the contributions of research to developing our resources and improving the quality of life in this province. Dr. Robert M. Hardy, one of the Research Council's longest serving members on the Board of Directors, was a distinguished member of the research and education community and it was most fitting that a plaque was dedicated at the opening ceremonies, naming a laboratory wing in his honor.

There is a worldwide explosion in technology taking place and the Alberta Research Council is in a position to respond to the needs of Alberta as the province moves into this era. We are still a very young province with vast untapped resources—both our natural resources and our human capabilities.

Developing our forestry resource is a huge challenge. The Alberta Research Council now has a research and testing laboratory to meet that challenge both in research for the construction industry by utilizing our aspen stands in panel product development, and by providing testing capabilities for the forestry industry.

The increase in high technology investment and commitment to long-term funding for research is attracting scientists and investors from around the world. The Research Council's biotechnology pilot plant is gaining a reputation for its fermentation facilities and expertise in the biotechnology community at large. Recently a California company, BIOSIS, has signed a contract for scale up of its biological insecticide which it hopes to be producing in commercial quantities here by late 1987.

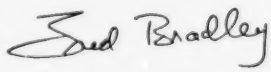
In October, the Electronic Industry Information Centre was officially opened in the Research Council's Calgary location. This three-year pilot project is in response to the growing needs of a vital and expanding segment of the Alberta economy.

The Electronics Test Centre, located in the Edmonton complex, provides evaluation, testing and consultative services to electronics and telecommunications manufacturers to meet Canadian and international requirements, and has handled more than $600,000 in contracts this year.

I would like to acknowledge the dedication of our able Board of Directors. This year marked the retirement of four valued members, Jack Nodwell of Calgary; Jack E. Pike, Aage F. Tottrup and Dr. Don Stanley of Edmonton. The Board of Directors also greatly benefited from the leadership and counsel of my predecessor and colleague, Eric Musgreave, who served as Chairman for five years. We tender our warmest wishes and our gratitude for their considerable contributions to the Research Council.

I take this opportunity to welcome the new directors appointed this year: the Honorable Larry Shaben, Minister for Alberta Economic Development and Trade; the Honorable Les Young, Minister of Alberta Technology, Research and Telecommunications; Clay Iverson, Medicine Hat, former Chief of the Defence Research Establishment, Suffield, Alberta; John R. McDougall, Edmonton, President of DALCOR Innoventures Ltd.; Dr. George B. Miller, Calgary, President and Director of Research for Nova Husky Research Corporation Ltd.; Dr. Irene Teitz, Calgary, Clinical Laboratory Scientist, Calgary General Hospital, and the first woman to be appointed to the Board.

A summary of the work for 1986 is contained in the pages of this annual report. It reflects the diversity of the Alberta Research Council and the commitment of its management and staff to work with industry and the public sector to advance the economy of the province.



Fred D. Bradley, M.L.A.
Chairman of the Board of Directors

President's Report

I am pleased to report that 1986 has been a year of considerable achievement at the Alberta Research Council. After five years of planning and construction, the new laboratory and headquarters complex was officially opened by Premier Don Getty on September 30. It is solid testimony to the commitment on the part of the government and the people of Alberta toward research and recognition of the advantages research can provide for the province. The official opening, attended by some 350 representatives of industry, government and the research community, afforded staff an opportunity to show our guests this magnificent facility. It was most gratifying to hear Premier Getty's encouraging remarks and his view that the Research Council is in a unique position, capable of responding to the needs of the province in research and development.

The Alberta Research Council has continued to shift its role toward adaptive and applied research which will have a direct impact on the economy of the province. A corporate mission statement, reflecting this role and embodying the priorities of the Research Council, was adopted this year.

The mission of the Alberta Research Council is "to advance the economy of the province by promoting technology development, performing applied research, and providing expert advice, technical information and scientific infrastructure that is responsive to the needs of the private sector and supports the activities of the public sector." This statement provides a clear message to our staff: of the importance of their work to the Alberta economy; that the Research Council is a key link in transferring technology to industry, and therefore should play a leading role in the province; and that staff should take pride in such a leadership role.

We now have the space and equipment to allow our staff to pursue expanded activities by working with industry in the key areas of forest products, biotechnology and industry-related research development and testing.

The Forest Products laboratory provides Alberta's forestry industry with the unique capability to design and produce prototype wood panels, using Alberta feedstocks. The most recent such prototype is a corrugated design for "waveboard" made from aspen chips which has been patented. Waveboard is considered a potential replacement for many present building systems such as stud walls, conventional floors and light industrial roofs.

We have made great strides in the Biotechnology Pilot Plant with the installation of a 7,500-litre fermentor and the funding commitment for a 15,000-litre fermentor which should be installed by the end of 1987. This will allow the Research Council to provide a fermentation capacity which for some products will be of commercial scale, and for others of full pilot plant scale. A contract was signed with a California biotechnology company, BIOSIS, to scale up entomogenous nematodes (microscopic insect-killing organisms) for use as a biological insecticide. By late 1987, it is expected that the Research Council will be in limited trial production of the BIOSIS product.

The Electronics Test Centre has completed its first full year of operation. In 1986, the Test Centre had in hand 170 projects from 111 Alberta companies. This represents virtually all the electronics testing service business in Alberta. The Test Centre has achieved significant market penetration in the other western provinces: British Columbia accounted for 18 percent, Manitoba and Saskatchewan for six percent of the Test Centre's projects. The current economic downturn has had a major impact on research and development spending in the private sector, which has had a negative effect on projected Test Centre revenues. Despite the fact that revenues are below original forecasts, the Test Centre has handled more than $600,000 in contracts in 1986.

Joint research ventures with small and medium-size companies continue to be among the Research Council's most successful initiatives. The work on the $700,000 joint research venture with Q.C. Data Collectors of Calgary, to design a vector editing workstation for translating map data from hard copy to computer memory, was completed on time and within budget. As a result, there is an Alberta-made technology which Q.C. Data expects to introduce into the marketplace in the next few months.

The joint research venture with another Calgary firm, Veritas Software Ltd., to develop 3-D vertical seismic profiling, has resulted in new technology for the geophysical industry. Although this project is only halfway to completion, Veritas is already marketing portions of the computer software in Alberta and internationally.

A new two-year $1.9 million joint research venture contract was signed during the year with Computer Based Training Systems Ltd. of Calgary to develop an expert system for computer managed learning technology.

The Alberta Research Council entered a coopera-

The Alberta Research Council has continued to shift its role toward adaptive and applied research which will have a direct impact on the economy of the province.

tive program with the National Research Council to deliver improved technical and information support to industry and more efficient delivery of Industrial Research Assistance Program (IRAP) funding in Alberta. This arranagement is a "first" in Canada and may serve as a model which could be used by other provincial research organizations. NRC also has announced an additional $700,000 in IRAP funding for Alberta.

The Coal Research Department has a number of contracts for further research in agglomeration and liquefaction co-processing of coal and bitumen/ heavy oil. During the year, Hydrocarbon Research Inc. (HRI), New Jersey, announced that it had successfully demonstrated its ebullated-bed reactor technology for converting mixtures of coal and heavy oils into high quality liquid fuels. The Research Council is a partner in the project through its extensive experience in co-processing research.

A three-year agreement with Texaco Canada Resources for oil sands-related research was signed in February. This agreement extends the cooperative arrangements with the Research Council's longest standing industrial client.

On October 15, the Hon. Les Young, Minister for Technology, Research and Telecommunications, and a member of the Research Council's Board of Directors, officiated at the inauguration in our Calgary offices of the Electronic Industry Information Centre. This centre has been established to improve the competitiveness of Alberta's electronic and software industries through provision of world-class information services.

The creation of the Department of Technology, Research and Telecommunications early in the year has signalled a change in the reporting route for the Research Council. The Research Council now reports to the Minister of that department. As an organization, we have formed a good working relationship with the staff in Technology, Research and Telecommunications and together we are increasing the profile and the activity in technology and research in Alberta.

To better serve our industrial clients, some internal adjustments were made during the year. Within the Applied Sciences Division, a new department of Industrial Technologies was created, amalgamating the former Materials and Testing and the Chemistry departments.

We were deeply saddened by the deaths of two of our staff, who had made considerable contributions to the Alberta Research Council. Dr. Sat Parkash, one of the Research Council's most capable scientists, was responsible for setting up the coal petrographic analytical facilities. Gary Martin was an outstanding manager, first as Head of the Oil Sands Research Department, and at the time of his death, Head of the Coal Research Department.

The interior outfitting in the high head laboratory is under way. A $1.6 million contract was awarded to Eden Construction Limited, Devon, in December, and the work is expected to be completed by July. However, the government's announcement of spending restraints will have an impact on the Research Council, both in capital project planning and in manpower. While the Devon laboratories will be completed, the plans for new accommodations at Clover Bar to replace the temporary trailers is on hold. The specific decision by Alberta Agriculture not to support further fieldwork in hail suppression research will require a reassessment of the Atmospheric Sciences Department.

We have every reason to be proud of our diverse accomplishments during the year. On the other hand, the coming year promises to be difficult and challenging. I have full confidence that we will be able to meet these challenges as we have others in the past.

Robert W. Stewart
President

Energy

Oil Sands

In oil sands research the Alberta Research Council has developed a technology and expertise base, composed of both trained personnel and advanced technical hardware of world class stature, and both data and process concepts are being applied in the field. During the past five years, Alberta Research Council staff have been investigating the use of steam-based processes for in situ recovery of oil from heavy oil and oil sands deposits in Alberta; a major part of this work is jointly funded with the Alberta Oil Sands Technology and Research Authority (AOSTRA).

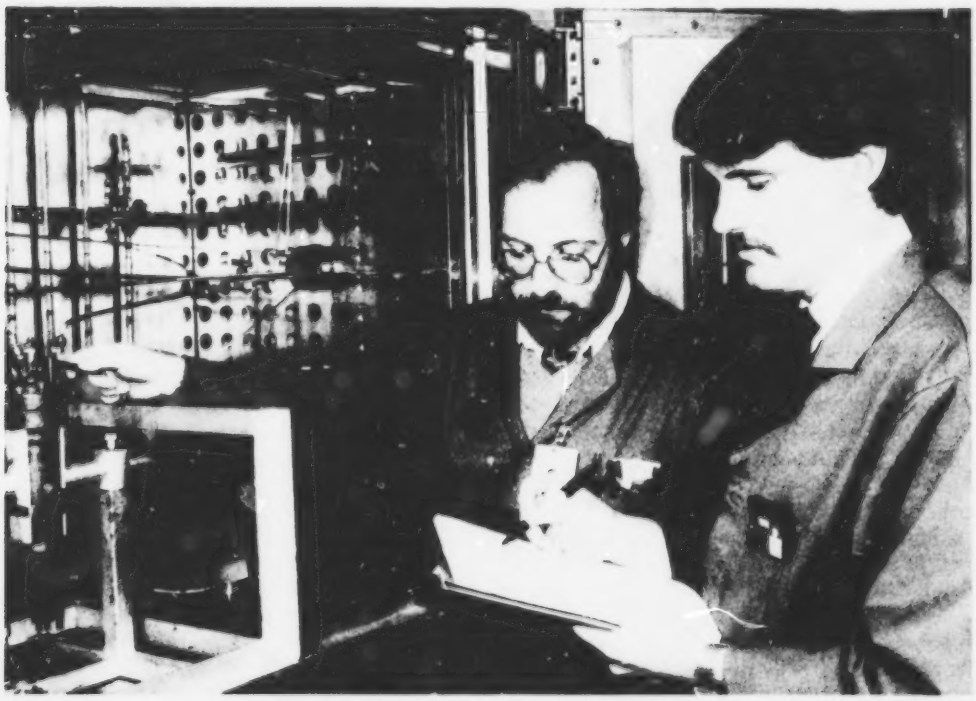
To facilitate the transfer of technology to field applications, this joint program was restructured this year into the Core Program, funded equally between the Research Council and AOSTRA; and a Strategic Program, funded totally by AOSTRA. Under the Core Program, the Alberta Research Council focuses on regional generic problems, evaluates and verifies novel concepts, investigates fundamental reservoir mechanisms, supports long-term technology development, and makes information available to members of AOSTRA's Industry Access program.

In the Strategic Program, researchers work on site-specific problems, further develop process concepts from the Core Program and the AOSTRA/University program, focus on process development for field application, support short- and medium-term needs and evaluate innovative process concepts from other sources.

The success of an enhanced recovery process, either for conventional oil or heavy oil, depends on the ability of the operator to inject and produce large volumes of fluids. Laboratory and field analysis have shown that every field operation—drilling, completion, production—is a source of potential reservoir damage that can limit potential productivity. Scientists recognize the significance of the near-well region and are developing techniques to evaluate formation damage. Recent developments in the theories of colloid chemistry have contributed to the understanding of physical damage by movement of fines. Alberta Research Council scientists can now calculate the conditions under which fine particles can be mobilized from the surface of larger grains and experimental studies on real field cores are confirming these theories. The researchers are working on techniques to eliminate or minimize permeability damage in the near-well region. The research is strongly supported by industry, including one oil company with no direct Alberta interests, and has generated more than $500,000 in direct contract revenues over the past three years.

A common problem encountered during steam injection processes is the heterogenous nature of the reservoir. High permeability steals valuable steam. Injection of a foam has been tried to plug the thief-zone and divert the steam flow to more productive regions, thus enhancing oil production. Although the reported success rate in the field has been less than 50 percent, due to instability of the

The Alberta Research Council supports long-term technology development and makes information available to members of AOSTRA's Industry Access program.



Chemical engineer Paul Henning, right, from the BP Research Centre, Sunbury, England, spent six weeks at the Alberta Research Council conducting research on relative permeability of Alberta bitumen and water. Here he confers with Research Council engineer Marcel Polikar.

Ron Dietrich from CHEMEX LABS analyzes diesel samples for saturates and aromatics. The cooperative effort between CHEMEX and the Alberta Research Council to develop a better analysis method for diesel fuels has resulted in technology which can be offered by a commercial laboratory as a service to industry.

The Alberta Research Council is now assisting Esso Resources Canada Ltd., representing a consortium of several oil companies, and Gulf Canada Corporation in developing processing strategies for their oil sands leases.

foams in the reservoir, laboratory experiments have led to discovery of conditions for generating the foams at steam injection conditions with promising results.

Mathematical models explaining the effects of steam additive processes and the transport of silica and other minerals are being used by the Computer Modelling Group in Calgary to develop commercial simulators with greater physical reality to predict and optimize oil production from reservoirs.

The Karl Clark hot water process recovers almost all of the bitumen from high-grade Athabasca oil sand in commercial operations, but significant losses of bitumen from low-grade ores often occur. Research Council scientists have found the losses were due to an interaction between the fines and salts in the low-grade ores. Under conditions of low pH or high salt concentration in the conditioning drum, fines in the oil sand will coagulate. In low concentrations, the fines contaminate the bitumen froth and place a burden on the froth clean-up units. In high concentrations, they cause the bitumen to sink and be lost in the tailings ponds. Scientists have identified the conditions necessary in the process to prevent the fines from coagulating by increasing the water to oil sand ratio and reducing the caustic addition compared to that used in conventional conditions. Major improvements in recovery have occurred in testing programs. The Alberta Research Council is now assisting Esso Resources Canada Ltd., representing a consortium of several oil companies, and Gulf Canada Corporation in developing processing strategies for their oil sands leases.

The Alberta Research Council set up a consortium of three oil companies (Suncor Inc., Petro-Canada Inc. and Shell Canada Resources Ltd.) and a California high technology firm (Science Applications Inc.) to see if instrumentation could be developed to measure the composition of production fluids from heavy and light oil reservoirs. This research has resulted in an advanced metering technique using neutron activation and high and low energy gamma rays to measure fractions of oil, water, gas and solids in flowing pipe systems. More recently the Alberta Research Council has brought into the picture two additional oil companies and Atomic Energy of Canada to extend the study and build a prototype instrument to be tested in the laboratory. This type of effort brings together the ultimate user at the research stage, multiplying the success capabilities and ensuring that the development follows the real needs of Alberta industry.

With increased use of synthetic crudes from heavy oil and bitumen, the oil industry requires a better method for analyzing diesel fuels and heating oils to maintain product quality. This demand led to a co-operative effort between the Alberta Research Council and CHEMEX LABS (Alberta) LTD., a commercial laboratory, to jointly develop such a method. The project was funded by CANMET. CHEMEX staff worked in the Research Council's laboratory, training and testing the method and analyzing real samples. They also compared the results to other analyses CHEMEX routinely performs for industry. The technology can now be offered by the commercial laboratory as a service to industry. Analytical support was also provided to identify suitable oil sands feedstock and to monitor the aging of stockpiles used for the evaluation of a new oil sands extraction process using solvents instead of hot water.

Coal

The objective of research in co-processing of coal and bitumen is to evaluate its economic advantage over heavy oil and bitumen upgrading. The Office of Coal Research and Technology and CCLC Technologies Inc. have been funding research in this field. Although the technology for liquefaction co-processing of coal and bitumen/heavy oil, developed by the Alberta Research Council, is competitive with other new technologies, an economic study has indicated it is less attractive than a new German process, Pyrosol. Under a contract to study the suitability of the Pyrosol process to Alberta coals and bitumen, research staff completed phase one. They constructed

a laboratory scale hydrocoker and bench scale Pyrosol unit, completed the "proof of concept" stage, and established a process suitable for co-processing Alberta subbituminous coal with heavy oil.

Hydrocarbon Research Inc., of Lawrenceville, New Jersey, announced during the year that it had successfully demonstrated its ebullated-bed reactor technology for converting mixtures of coal and heavy oils into high quality liquid fuels. This technology could help introduce two of Alberta's major energy resources into Canadian and American liquid fuel markets. The Alberta Research Council, which is a partner in the project through its extensive experience in co-processing research, conducted studies for the characterization and reactivity screening of feedstocks. Other partners in the project are the Ontario-Ohio Synthetic Fuels Corporation Ltd., the State of Ohio and the Electric Power Research Institute of Palo Alto, California.

Small amounts of heavy oil or bitumen added to coal-water slurries produce agglomerates—balls of high quality coal up to the size of marbles—when pumped through a pipeline or stirred in a tank. The agglomeration process results in the simultaneous beneficiation of different ranks of Alberta coals by removing ash detrimental to conversion processes and suppressing the absorption of moisture. When applied to subbituminous coals, this process generates high calorific value solid fuel, characterized by very good combustion properties. Furthermore, this process generates, during preheating of agglomerates, high quality asphaltene-free, distillable oil. Results of preliminary economic analyses underscore great potential for the agglomeration/oil purification process.

Agglomeration technology was also applied to coal from the Whitewood Mine at Wabamun and an economic analysis of the results carried out under contract to Manalta Coal Ltd. For BC Research, coal from Hat Creek, B.C. was beneficiated through agglomeration.

Sufficient interest in agglomeration work at the Research Council has been generated within the United States electric power industry for opening formal discussions during the year towards formation of an international consortium to further research in the field.

The Office of Coal Research and Technology contracted the Alberta Research Council to develop a joint industry and government coal combustion research program. The combustion group also developed in-house facilities to study the combustion properties of solid fuels. As part of this work, a collaborative project with Sandia National Laboratories, of Livermore, California, to investigate the combustion reactivity of Alberta coal maceral fractions, was completed.

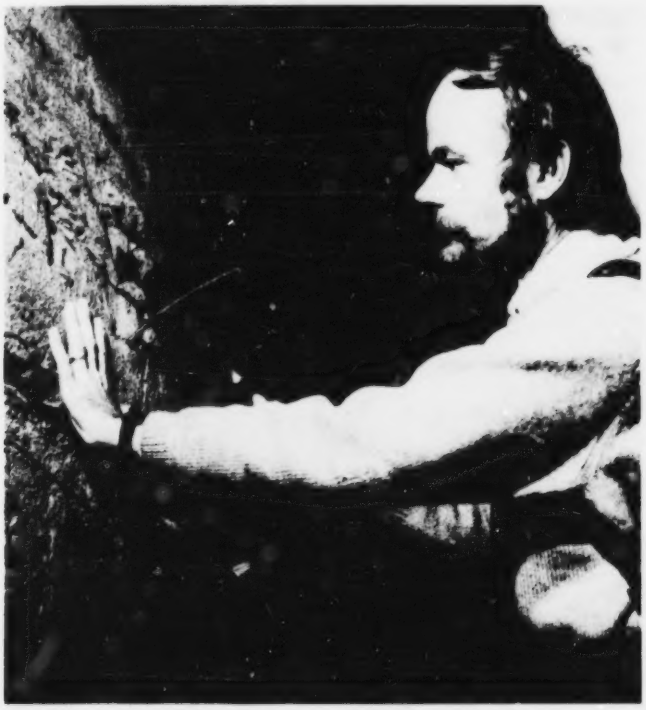
An extension of the agglomeration research is the development of the Alberta Research Council's AGLO-FLOAT process for cleaning coals. Technologist Yevgenia Briker works on the experiment.

The objective of research in co-processing of coal and bitumen is to evaluate its economic advantage over heavy oil and bitumen upgrading.

Hydrocarbon Upgrading

By the end of 1986, the Alberta Research Council had completed most of a three-year first phase in a joint research project with AOSTRA in hydrocarbon upgrading. The major thrust of this first phase has been the development of a solid base of facilities and expertise to carry out research in bitumen upgrading. The research staff developed an understanding of process chemistry in current upgrading technology, studied catalysis based on commercial catalysts for both primary and secondary upgrading, and studied how the byproducts of upgrading, residue and pitch could be

Geologist Dr. Willem Langenberg investigates structurally thickened coal at the surface. The field data is used as the basis for predictions of subsurface mineable coal.



Geological information is fundamental for companies planning development of in situ oil sands and heavy oil deposits.

converted to useful products. This work has opened the door to future industrial contracts and joint projects with AOSTRA and energy resources companies.

Energy Resources Geology

The Alberta Research Council evaluates the province's coal resources, providing geological information to assist government and industry in research and development. This year, a new three-year contract was signed with Alberta Energy, committing $1.2 million from both the Alberta Research Council and Alberta Energy to further studies in coal geology.

An overview study on the present status of coal geological research in Alberta is nearly complete and will provide Alberta Energy with a framework for administering coal geology research funds. These research funds are available to universities and the private sector as well as the Alberta Research Council.

Enormous new resources have been delineated in studies of the Horseshoe Canyon, Belly River and Paskapoo Formations. Reports on the studies of these regional coal resources were completed this year and a fourth report describes the quantitative estimates of the resource, providing government planners with an improved resource information base. The coal industry also has expressed interest in these reports to help guide their initial exploration programs.

Structurally thickened coal in the foothills regions and mountains can be identified through computer-produced cross sections, and is useful to mine owners in overall site development. The Alberta Research Council and Smoky River Coal Limited have cooperated to prove the methodology and it has been used successfully to help in defining a new mine.

Geological information is fundamental for companies planning development of in situ oil sands and heavy oil deposits. The Alberta Research Council, supported by the Alberta Oil Sands Technology and Research Authority, conducts major regional investigations of Alberta's oil sands and heavy oil deposits. These investigations have produced an extensive data base and geological expertise that is unique both within and beyond Alberta. The staff assembled through the Oil Sands Geology Program have provided significant technical guidance to, and evaluation of, geological concerns associated with a large number of AOSTRA-supported thermal pilot projects.

In 1986, the Research Council and AOSTRA jointly sponsored a series of workshops on each of the major oil sands deposits and the heavy oil belt for companies involved or interested in thermal recovery of in situ pilot projects. The workshops dealt with the geological parameters which can affect pilot siting and operational strategy and were followed by a major geology forum.

Under its joint program with AOSTRA and Alberta Energy, the Alberta Research Council has continued resource characterization of the central Athabasca and northern Cold Lake areas. The oil sands geology group also is conducting a major geological review of the Buffalo Creek-Saleski-McLean thermal pilot operation for UNOCAL Canada.

A new initiative undertaken in 1986 is a detailed reservoir study focusing on a heavy oil pool in which the rock, pore system and distribution of fluids in the system are being examined. Such studies will lead to more effective reservoir engineering and predictive modelling of heavy oil resources.

A report on a subsurface study of the Jurassic-Cretaceous reservoir in the Niton oil field was completed for Alberta Energy. The information provides legal definitions of hydrocarbon reservoirs and productive zones and facilitates negotiations between government and industry on lease arrangements and deep drilling rights.

Coal Mining

Highwall failure in Plains Region open-pit coal mines can be related to structural faults in glacially deformed bedrock. Highwall failure is not only a safety hazard, but can result in expensive disruptions to operations. With joint funding from TransAlta Utilities Corporation and the Alberta Research Council, scientists are developing methods for detecting glacially thrust bedrock and determining its distribution, structure, and contribution to highwall failure.

In 1986, research projects were conducted in both the Highvale and Whitewood Coal Mines and a model for highwall failure was developed. A related project, funded by the Office of Coal Research and Technology and several coal companies, to evaluate the use of surface geophysical techniques for the detection of glaciotectonic terrain and coal seam continuity, is nearing completion. The research team is also helping CANMET and TransAlta Utilities test the suitability of new downhole instrumentation for measuring in situ rock strength.

Agriculture

Crop Improvement

In a Research Council funded project, plant tissue culture has resulted in approximately 4,000 candidate alfalfa cultures, which have been tested at the Canada Agriculture facilities in Beaverlodge, Alberta, and at the Experimental Farm of the University of Alberta in Edmonton. Under a contract from the National Research Council, which was completed this year, plant tissue cultures of wheat have been used to help select for cold-tolerance and freezing resistance. Similar techniques have been used to assist Plainsman Manufacturing Inc., Edmonton, in attempting to develop new varieties of crops which are grown elsewhere, but which could become useful in Alberta.

Frost damage to crops is a serious problem in central and northern Alberta. Such damage may occur at temperatures only slightly below 0 °C because of the presence of ice-nucleating bacteria on plants which initiate ice formation. Studies conducted in California, Florida and Wisconsin show that there are two species of ice-nucleating bacteria. Ice-nucleating bacteria in Alberta may be different from those occurring in the United States.

Alberta Research Council

In a Research Council funded project, 4,000 plants from tissue culture have been tested.

Technologist Twyla Malcolm tends alfalfa plants regenerated from tissue culture in the Biotechnology laboratory.

Near Forestburg, Alberta, Greg Sterenberg installs datalogger and instrumentation for a climate monitoring station at a study site for salt migration.

The success of programs to treat water seeps and saline soils depends on a clear understanding of the specific causes of salinity.

scientists studying isolates from crop plants grown at the University of Alberta farm in Edmonton have identified a strain of species, *Pseudomonas fluorescens,* which is different from two bacterial species, *Pseudomonas syringae* and *Erwinia herbiola,* inherent in the United States. These Alberta isolates clearly show psychrophilic (cold-loving) characteristics with respect to optimal growth temperatures and membrane lipids which need to be controlled to minimize frost damage.

Soil and Water

It is estimated that soil salinity costs Alberta farmers from $30 million to $80 million each year in lost productivity. The success of programs to treat water seeps and saline soils, which involve a cost to the province and a financial risk to the farmer, depends on a clear understanding of the specific causes of salinity. In 1986, a detailed drilling, piezometer and water-table well monitoring program was carried out in the vicinity of a major area of saline soil near the town of Carmangay, in southern Alberta. Scientists were able to distinguish between areas where soil salinity was caused primarily by accumulation of excess surface water of snow-melt origin, or by discharge of highly mineralized groundwater.

In east-central Alberta, researchers have identified several locations where the water flow from regional subsurface aquifers is a major contributor to soil salinization. Data from wells, installed by the Alberta Research Council during the summer of 1986, indicate that the hydraulic head in the aquifer underlying a 150-square kilometre area near the town of Forestburg is at, or near, the land surface in areas of severe salinity. Work is continuing in both of these locations to define appropriate and effective remedial treatments.

In a continuing study of soil erosion in east-central Alberta, researchers have observed that rapid spring snowmelt can be a significant cause of soil erosion in summer-fallowed fields in hummocky terrain. A single event in February of 1986 resulted in the loss of 8.5 tonnes of soil from an area of approximately 4.4 hectares at one of the study sites.

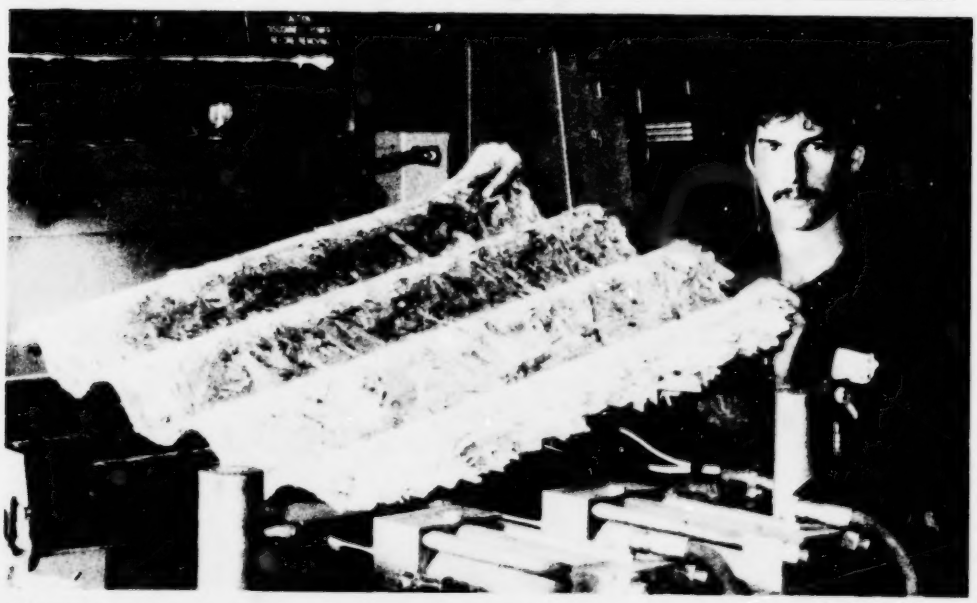
Weather Modification

The Alberta Research Council has been the prime agency for weather modification research and operations in the province. Results achieved during a five-year research program completed last year were analyzed and presented in a report to

Alberta Agriculture, which largely sponsored the program. The report concluded: the current conceptual model of a typical Alberta hailstorm is essentially correct; cloud seeding can potentially increase the number of hail embryos that develop in a storm, thus limiting their size. In some storms, these hailstones can be made to fall out of the storm prematurely, thereby preventing the growth of the embryos to larger and more damaging hailstones. A decrease of about 20 percent in the loss-to-risk ratio calculated from crop insurance data could possibly be attributed to cloud seeding. From observations of hail on the ground, researchers have determined that cloud seeding can affect the number of hailstones that fall. What has not yet been established is whether cloud seeding significantly alters the hail that falls to the ground and hence reduces crop damage. It has been established that some cumulus clouds which would not rain naturally can be made to rain by cloud seeding and these types of clouds are as prevalent in periods of drought as in periods of normal rainfall. It appears that seeding such clouds could add 10 mm of rain during the growing season in southern Alberta. Preliminary research into cloud seeding for snow augmentation suggests that a potential exists for increasing snowpack and therefore spring runoff in the southern Rockies of Alberta.

Forestry and Forest Products

Completion of the panel development laboratory provides Alberta industry with a unique capability to design and produce prototype wood panels, using Alberta wood feedstocks.



In the Forest Products laboratory, Peter Taylor displays waveboard from the specially designed press which creates the corrugated shape. The technology for producing the prototype waveboard was developed at the Alberta Research Council and was patented in 1986.

Alberta's forestry resources are a major component of the province's economic base. The province's stock of spruce, pine and fir make up the largest uncommitted reserve of commercial softwood in Canada and Alberta's hardwood aspen stands are the biggest in North America.

The goal of forest products research at the Alberta Research Council is to increase and improve the commercial utilization of Alberta's forest resources, particularly aspen, through product evaluation, development and research. Projects in engineered wood composites have been identified as the best opportunity for upgrading "low diameter wood resources," particularly aspen, to structural materials.

Completion of the panel development laboratory provides Alberta industry with a unique capability to design and produce prototype wood panels, using Alberta wood feedstocks and to carry out tests which assist in the optimization of panels from an economic standpoint. This laboratory will provide a service to Alberta industry but the market for services generally is Canada and the United States.

The successful production of prototype "waveboard" at the 0.63 m x 1.22 m size is another milestone. This board has a unique design which in tests has proved that board stiffness can be considerably improved by corrugation. If successfully developed to commercial size, "waveboard" is seen as a potential replacement for many present building systems, particularly stud walls, conventional floors and light industrial roofs.

The panel testing laboratory successfully passed the

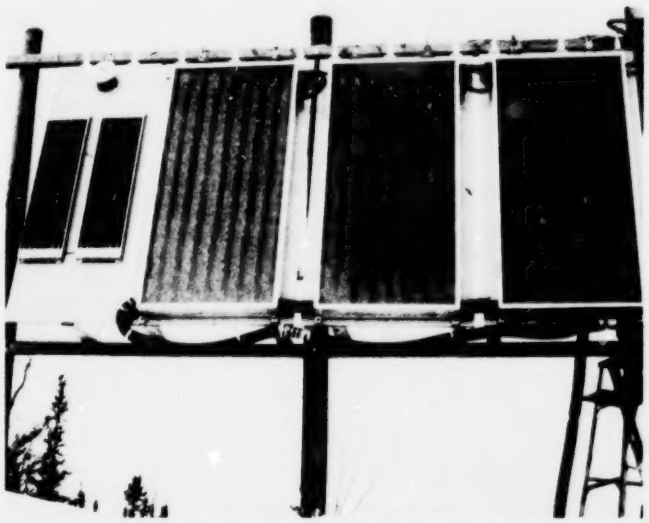
annual recertification requirements of the Standards Council of Canada. Several runs of commercial panels were tested in accordance with Canadian Standards Association and American Plywood Association standards for certification by Canada Mortgage and Housing Corporation. As a result, new structural panels developed by Alberta industry were accepted for use in housing and the area of acceptance for some existing panels was expanded.

Considerable progress was achieved in the development of an automated machine stiffness rating system for panel products, a program which took place mainly on location in Alberta mills.

The construction and testing of stress skin panels has shown that it may be possible for Alberta-produced oriented strandboard to be successfully substituted for imported plywood used in this type of building system.

Transportation

The Alberta Research Council represented Canada on one of the task groups developing the proposed United States multi-million dollar five-year Strategic Highway Research Program.



Solar panel collectors heat an antifreeze solution pumped through a closed-loop pipe system installed in a culvert to prevent ice blockage. The solar ice-thawing system was devised by Alberta Research Council engineers for Alberta Transportation.

The National Pavement Impact Study was completed with submission of the final report to the client in the summer of 1986. This report analyzed the results of tests, conducted across Canada by the Alberta Research Council in 1985, to determine how various highway pavement types identified by the provinces respond to selected combinations of freight truck axle loads. Essentially, this was an outgrowth of work conducted jointly by the Alberta Research Council and Alberta Transportation for the last decade. The confidential report will now be considered at the federal/provincial level with the objective of developing more uniform regulations for interprovincial truck traffic, thus promoting economies in motor transport costs with eventual benefits to the consumer.

The modern era of smaller passenger cars and larger, faster trucks in the traffic stream calls for a re-evaluation of factors that influence the capacity and level of service of the rural highway system. The objective of an Alberta Research Council study is to determine the most cost-effective solutions to operational problems and these can range from simply changing road markings to provision of extra lanes. Activities have been concentrated on the development of methodologies for the collection, analysis, and description of traffic operational characteristics, using existing field data and computerized simulation models.

In joint research arrangements with Alberta Transportation, further development and refinement was made to the Pavement Management System, a computerized data base and management tool. Particular emphasis was given to redevelopment of mathematical equations to predict the time at which given road sections reach the end of their service life, and to identify the major contributing factors. Such periodic analyses, updated and modified as the road system evolves and changes, are valuable tools to decision makers in optimizing planning decisions.

Wintertime icing of road surfaces due to ice-blocked culverts can pose a safety problem. Thawing the culvert ice is simple but can prove expensive and time-consuming in remote areas without electrical power. A culvert ice-thawing system, activated by solar energy, was designed by the Alberta Research Council and installed by Alberta Transportation on the David Thompson Highway near the Banff Park boundary. Solar panel collectors heat an antifreeze solution which is pumped through a closed-loop pipe system installed in the culvert. Data collection and field observations conducted during the winter of 1985-86 validated the design calculations and the effectiveness of the system. During a second winter of observation, system improvements were being monitored to corroborate the estimated cost savings of the application.

The Alberta Research Council represented Canada on one of the task groups developing the proposed

United States multi-million dollar five-year Strategic Highway Research Program and is contributing to a proposed parallel Canadian program. This has resulted in a number of national and international enquiries for technical assistance in the area of pavement instrumentation and dynamic load monitoring. Development of improved, low-cost instrumentation to meet these emerging needs and identification of a potential market niche for local manufacturers is being investigated.

Environment

Land Reclamation

The Plains Hydrology and Reclamation Project, a multidisciplinary and cooperative study by government and industry, partly funded by the Alberta Heritage Savings Trust Fund, completed its eighth year. Researchers have been developing techniques for reconstructing mined landscapes to maximize long-term productivity. Initially, reclaimed soils appear to have a capability for agriculture similar to soils prior to mining. In some places, however, this initial capability declines as shallow water-table conditions develop, leading to loss of productive agricultural land because of development of ponds and soil salinization.

In 1986, research at the Smoky River Coal Limited operations near Grande Cache entailed an assessment of invasion by native species vegetation into previously revegetated, reconstructed soils areas. A comprehensive study to assess the revegetation potential of spoil dumps characterized by steep slopes (28 to 35 degrees) and varying types of surface materials also was initiated. Scientists found that natural invasion by native plants is substantial and results in a major contribution to achieving the ultimate goal of establishment of a self-sustaining plant cover. In some areas, vegetation can be established on steeply sloping spoil dumps without the need to undertake any resloping or topdressing with soil material. The results confirm that long-term reclamation costs can be reduced and reclamation achieved, thereby conserving the land resource and protecting the environment.

Long-term reclamation costs can be reduced and reclamation achieved, thereby conserving the land resource and protecting the environment.

Scientists working on reclamation of lands after surface coal mining have found that natural invasion by native plants to these reclaimed areas is substantial. Zdenek Widtman measures the height of an alder plant that has become established by natural processes.

Water and Earth Resources

Petroleum companies engaged in the development of in situ oil sands and heavy oil upgrading are required to dispose of the chemical waste water produced at the plants by injection into deep underground wells. The management of water resources used in plant operations and the long-term environmental impact of deep waste disposal is a major concern for both the plant owners and provincial regulatory agencies.

In a project jointly funded by Alberta Environment and the Alberta Research Council, scientists are evaluating the effects of deep water injection at 25 sites in the Cold Lake area for projected rates of injection to the year 2015, using numerical modelling methods.

This study, encompassing previous work on the Cold Lake region, covers an area of 60,000 square kilometres extending into Saskatchewan. Information from more than 15,000 oil wells, concerning stratigraphic tops, formation water chemical analyses, drillstem tests and core analyses, is being used for the hydrogeological study of the natural flow regime in the entire

A study to determine the feasibility of using sludge, the byproduct of a heavy oil plant water treatment process, as an effective soil liming agent was carried out near Bonnyville. Technologist Bob Faught tests the soil pH in a harvested barley plot where the sludge was spread.

Staff completed work on a water management plan covering the environmental impact of deep waste disposal.

sedimentary rock sequence above the Precambrian basement.

In another study for Husky Oil Operations Ltd., the staff completed work on a water management plan covering the environmental impact of deep waste disposal needed by the company for its heavy oil upgrader bi-provincial project at Lloydminster, Saskatchewan.

In cooperation with Suncor Ltd., the Alberta Research Council is studying the feasibility of spreading a high-lime content sludge on land. The sludge is a byproduct of the water treatment process at Suncor's Fort Kent heavy oil plant. Results of field plot studies indicate that the sludge is an effective soil liming agent and that it has no detectable deleterious effects on crop growth.

Scientists are assisting the Forest Land Use Branch, Alberta Forestry, Lands and Wildlife, in assessing the fate of pollutants in soils and their potential impact on plant growth in the area surrounding the Lodgepole sour gas well blowout site. In 1986, scientists provided advice on sampling design and techniques, and initiated the development of analytical methods that can be used for measuring petroleum condensate levels in soils.

A literature review and problem analysis of the present and potential effects of resource development activities on the waters associated with peatlands in Alberta is being conducted in cooperation with Alberta Environment. This will include an assessment of the impact of peatland drainage related to agriculture, forestry, or industrial development and an assessment of the impact of acid deposition.

Surface water, the streams and channels within which it flows, and the sediment it transports, has an impact on the economic development of Alberta. Floods, such as those experienced in the North Saskatchewn River and Pembina River basins in 1986, both destroy valuable land and infrastructure near rivers and replenish the fertility of the land within the flood plain. One major concern of provincial water management authorities is the prediction of river bank erosion. The Alberta Research Council has developed techniques to predict bank erosion rates and to optimize the design and placement of bank protection. A key element in this development was the ability to measure bed and bank erosion during an extremely large and rare flood on the Pembina River.

Staff are studying the impact of various types of forest harvesting practices on the hydrologic, sediment, and thermal regimes of small eastern slopes streams. They found that even with up to 50 percent of the stream catchment harvested, no significant changes in the hydrologic and sediment regimes could be detected. On the other hand, the water temperature in the streams was found to increase substantially, primarily because of the increased solar radiation reaching the water surface due to the removal of streamside vegetation.

The sediment carried in Alberta rivers has an impact on the design and operation of reservoirs, the performance of irrigation structures, and the replenishment of the aggregate resource in many areas. A project to examine the sediment sources and controls on sediment transport in the upper Oldman River basin was undertaken to evaluate the current approaches used in determining the sediment load in rivers. New techniques were developed, whereby the sediment load is related to the erosion and transport mechanisms in the sediment source areas. This technology can be applied to other rivers to produce a more rational assessment of the sediment regime.

Ice-jamming and related processes on Alberta rivers produce many large floods which are often much higher than open water floods. An ongoing project concerned

with ice jams on the Athabasca River upstream of Fort McMurray has successfully characterized the breakup process and developed procedures to analyse ice jam flood levels in the overall flood level analysis. Techniques are now being developed to forecast the onset and severity of breakup so that a flood warning procedure can be implemented.

Air Quality

In a joint pilot project with Alberta Environment, an experimental design was produced for a comprehensive study of brown haze over Calgary. In preparation for the proposed study, monitoring equipment and analysis procedures were designed, developed and tested to determine the chemical composition and size of pollutants, to produce preliminary urban and rural vertical aerosol distribution, and determine aerosol loading and the effect on solar radiation reaching the earth. The project involved the Alberta Research Council and staff from the Kananaskis Centre of the University of Calgary.

Meteorology

Special upper air processing routines developed by the Alberta Research Council are being used to process meteorological information collected during the Canadian Atlantic Storms Program (CASP), a project which studied storms in the Atlantic and which was largely funded by the Atmospheric Environment Service of Environment Canada.

In a project with Alberta Environment the Alberta Research Council developed the software and installed the telephone links to allow data from the federal Atmospheric Environment Service weather radars to be transferred and converted into color images of storms. This capability will assist Alberta Environment in preparing flow forecasts and flood forecasts for the various river basins throughout the province.

New geographic information systems (GIS) technology can help make the data more useful for operational and planning activities at the county level.

Natural Resources

Land Resources

The multidisciplinary land resource inventory of Flagstaff County by Alberta Research Council scientists has become a model for expanded cooperation with Alberta Agriculture and Agriculture Canada in a joint effort to build a uniform, intermediate-scale, soils data base for agricultural counties in Alberta. Complementary research projects undertaken in Flagstaff County are helping to define and extend the utility of the land inventory data base for county level and Alberta Agriculture planners and managers. There is considerable interest in determining how new geographic information systems (GIS) technology can help make the data more useful for operational and planning activities at the county level.

Terrain scientist Bob MacMillan, Alberta Research Council, and Leon Marciak, Land Use Branch, Alberta Agriculture, use Geographic Information Systems (GIS), a new technology for land use mapping and soils data base inventories.

The Alberta Research Council's newly acquired capability, using GIS to input and analyze computerized map information, has been instrumental in providing needed services to several clients. An initial joint investigation with Alberta Agriculture to determine how GIS technology might best be applied to existing operations was successfully concluded. It was an important factor in the decision by Alberta Agricul-

ture to acquire GIS hardware and software and to begin automation of some of its operational mapping requirements.

Detailed maps of the distribution and variability of soil properties were prepared to assist in the expansion of an agricultural research station and to characterize an Alberta Agriculture salinity research site. In another project, researchers designed formats to assist an urban fringe municipality in automating its land use mapping program and to define a workable proposal for an extensive automated data base of recreational suitability by quarter section.

Metallic and Industrial Minerals

The Alberta Research Council has a contract with Alberta Energy to secure and summarize existing information on selected mineral commodities and evaluate the quality of information to aid in the effective management of the province's mineral resources. Four commodity profile reports—on silica, gypsum, phosphate and dimension stone—were prepared in a standardized format which will form a standard source book for resource planners.

Under contract to Alberta Forestry, Lands and Wildlife, the Alberta Research Council is evaluating limestone prospects at several localities for potential use as white mineral filler in paper making. The study is in support of the Alberta government's efforts to attract the fine-paper industry to the province. It follows a previous investigation of the potential for kaolin clays—an alternative paper filler material.

Aggregate

Aggregate, essential in road construction, is one of the province's major non-renewable resources. Delineating and mapping new field areas of aggregate is undertaken each year by Alberta Research Council geologists under contract to Alberta Forestry, Lands and Wildlife. These maps give provincial and municipal planners the information they require for managing the resource and provide developers with inventory data.

Mapping and laboratory analyses were completed for three aggregate deposits at Bischo Lake-Hay River, Lesser Slave Lake, and an area north of Fort McMurray. Fieldwork was completed covering another 25,000 square kilometres in the areas of Calling Lake, Peerless Lake and Rocky Mountain House.

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Geologist Julian Fox examines minerals in rock sample during field work to delineate new areas of aggregate deposits.

Industrial Assistance

Industrial Development

The Service to Industry Program has three primary objectives: to solve short-term industrial problems through the provision of technical assistance and information; to provide access to the world's online published scientific and technical literature; and to arrange for financial assistance to commercialize technology from external sources including the National Research Council's Industrial Research Assistance Program (IRAP) in Alberta.

IRAP is a federal government program of the National Research Council, established to further the economic development of Canada through the encouragement of research and development and increased utilization of science and technology. In Alberta, this program is carried out by a group of technology advisors from both the Alberta Research Council and the National Research Council. They operate as part of a Canada-wide field network set up to assist industry to enhance the calibre and application of industrial research and development across Canada and to foster the use of available technology.

During 1986 assistance was provided to more than 2,000 companies in Alberta. Financial assistance was arranged for approximately 350 companies. The following are selected examples:

Brentwood Glassworks Inc. develops and manufactures high quality base color and clear glass bars for the art glass industry in North America. IRAP-L assistance allowed Brentwood Glass to utilize the ceramics expertise and testing facilities at the University of Calgary to analyze imported glass bars and determine that the glass could be produced using chemicals and raw materials

found in Alberta.

Following the success of the IRAP-L project, Brentwood embarked on research and development of a high quality, clear frit form base glass for the art glass industry. The intent is to utilize Alberta silica sand and again, where possible, Alberta chemicals and raw materials. In 1986, Brentwood Glass applied for IRAP-M assistance for further research on this project. Experts at the Alberta Research Council in Edmonton supplied information and locations of such sand. The project is progressing successfully and is serving to establish another innovative company which will contribute to Alberta's growing diverse industrial base.

Commonwealth Seager Group is in the cathodic protection business. In 1985 the company asked for assistance in developing an instrument to measure the effect of telluric currents on pipeline corrosion in the high northern latitudes. Telluric currents are electrical currents induced in the earth by auroral activity. They can be responsible for diminishing the effectiveness of cathodic protection systems which have been installed to protect northern pipelines from corrosion. In the past, there has been no suitable instrument available to measure the effect of telluric currents upon a cathodically protected pipeline.

Financial assistance through the IRAP-M program was provided to Commonwealth Seager to develop 'tellupol', an instrument which enables the reliable measurement of the effects of telluric currents on the level of cathodic protection maintained on a pipeline. This product is now being successfully marketed by Commonwealth Seager.

Delta-P Test Corporation of Calgary is an active oilfield service company mainly involved with closed chamber drillstem testing. Lloyd Alexander, president of the company, developed and patented a process for the testing of producing oil wells which is both simpler and more precise than traditional methods. Driven by strong market demand, the company requested assistance in the development of hardware and software to enable it to deliver field services in Canada and overseas and to capitalize on its technology edge.

Financial assistance was arranged from the IRAP-M program which enabled Delta-P to design and manufacture new hardware and, with the support of the University of Calgary, to create the required software.

Delta-P Corporation is now well-positioned to assist oil and gas producers to improve operating efficiencies. Services were immediately marketed in Canada while arrangements to market pro-

Glassblower Barry Fairbairn, Brentwood Glassworks Inc., Calgary, turns molten material into decorative art glass vase. Brentwood Glass has received IRAP support for research and development of its art glass manufacturing industry.

During 1986 assistance was provided to more than 2,000 companies in Alberta. Financial assistance was arranged for approximately 350 companies.

Branko Salaj operates the perforator/separator used by Applied Polymer Research of Edmonton in the production of blow molded planter pots. IRAP assistance has helped the company develop processes for recycling plastic beverage bottles.

Staff are frequently called upon to provide technical service and information to private sector companies, particularly small business, and government agencies.

ducts and services are being worked out.

Applied Polymer Research is an Edmonton company engaged in developing processes for the recycling of polyethylene terephthalate (PET) plastic material from beverage (soft drink) bottles. The company approached the Alberta Research Council for technical information assistance and a literature search was carried out on extrusion coatings, reuse of waste materials and plastic coatings. Assistance also was given through the IRAP-H program, by the placement of two engineering students which resulted in permanent positions for the students in the company. In 1986, through the IRAP-H program, the placement of students enabled the company to accelerate the pace at which a new manufacturing facility could be put into production. In addition, a student designed a patentable perforator/separator device to be used in the production of blow molded planter pots. In production of the blow molded planter pots, this perforator/separator improved product quality and reduced production costs by 10 to 15 percent, while increasing productivity by 20 percent.

Industrial Technologies

The Alberta Research Council carries out mission-oriented research and testing to assist Alberta industries with the development and commercialization of new or improved materials, products and processes. Research directed to the development and efficient use of Alberta's resources is actively promoted as is direct liaison with industrial clients. Such liaison is accomplished by having clients observe or participate in the work. Staff are frequently called upon to provide technical service and information to private sector companies, particularly small businesses, and government agencies.

In 1986, the Industrial Services Laboratory provided service to more than 200 Alberta individuals and companies. The majority of clients were small businessmen and entrepreneurs. Approximately two-thirds of the work was classed as small projects. They included testing of paint products, fire protection devices, asphalt materials, new tracing and architectural rendering materials, new biodegradable plastic materials, protective coatings, and flame retardants. Test methods were developed for the evaluation of the water permeability of paints.

In the medium-size range, contracts undertaken were continuing environmental surveys for several fertilizer complexes, the development of polymer modified asphalts, and the monitoring of feed materials for a forest products firm. In all cases, testing services were provided which were not available elsewhere in Alberta.

On a larger scale, an investigation was carried out for the Atomic Energy Control Board. A problem had arisen where radioactive material occasionally leaked from a certain type of radiographic camera during field use. The Atomic Energy Control Board had ordered "stop use" of a containment capsule within the camera pending isolation and resolution of the fault. Working closely with the manufacturers, changes in the capsule design and in the operation of equipment were recommended to safeguard workers. Savings in Alberta equipment and capsule sales through the work at the Research Council are estimated at $500,000 and further long-term savings could be more substantial.

Weather-Related Activities

The Alberta Research Council assisted its long-time supplier of weather modification services, Intera Technologies Ltd. of Calgary, in carrying out a weather modification project in Greece by seconding professional staff to supply much needed expertise in the field. The project in Greece is a three-year, $10 million contract for Intera. Staff also assisted Intera in training foreign students for weather modification activities in their homelands. Consulting services have been provided to Raytheon, an American corporation currently working on the development of a new weather radar system for the United States.

Alberta Government Telephones (AGT) contracted the Alberta Research Council to provide rainfall data from the Wetaskiwin area recorded by weather radar during the summer of 1986. Of particular interest was the intensity and duration of rainfall near microwave towers which can be correlated with fading of microwave telecommunication signals. If it can be shown that rainfall does not seriously affect the quality of telephone service using microwave signals, AGT will consider replacing existing land lines in the province with microwave towers.

The ability to forecast where lightning is most likely to strike when a storm is passing through an area could be a major advantage to electric utility companies. With advance warning of a possible lightning strike, a company could reroute electricity through alternate power grids to avoid power outages caused by the ensuing power surge. Using existing technology for processing data from its weather radar, the Alberta Research Council has developed a real-time system for forecasting where lightning will most likely strike through the projected path of a storm. The data for this project, under contract for the Canadian Electrical Association, have come from weather radars in Stony Plain operated by the federal government's Atmospheric Environment Service.

Flight through clouds composed of supercooled water droplets has posed an icing hazard to aircraft since commercial transport began in the 1930s. The United States Federal Aviation Administration (FAA) is reviewing the strict standards currently in effect. The instrumented research aircraft, developed jointly by the Alberta Research Council and Intera Technologies, has flown through and collected data from supercooled clouds during various weather modification research field programs since 1982. This data set is able to provide icing data for regions of North America and major weather categories which are underrepresented in the current FAA data base. These data now are being made available to the FAA through a contract with the University of Dayton (Ohio) Research Institute.

Information Centres

The Alberta Research Council operates information centres for the benefit of industry, government, the general public and staff.

Industrial Information

The services of Industrial Information Centres in both Edmonton and Calgary provide industry with a direct link to more than 95 percent of the world's published scientific and technical literature in databases from Canada, the United States and Europe.

In 1986, Industrial Information enhanced its information delivery capability with the introduction of voice/data conferencing through Telecom Canada's iNet 2000 network. Through telephone and computer terminal links, this communication network enables an information specialist and client to share the same information on their terminal screens when doing an online literature search. Additional terminal telephone/computer links to the conference enable scientific and technical experts to be part of the information search and delivery process.

Industrial Information carried out close to 1,400 online searches for our technology advisors and industrial clients. From the search results provided, more than 2,200 documents were ordered and delivered to clients.

Electronic Industry Information Centre

The Electronic Industry Information Centre is a three-year pilot project established to improve the growth and competitiveness of Alberta's electronic and software industry through the provision of world class information services. The Alberta Research Council has received funding from Alberta Technology, Research and Telecommunications to set up and demonstrate the project. The Electronic Industry Information Centre was officially launched October 15 and currently has more than 100 users online.

The Electronic Industry Information Centre provides access to international data bases and proprietary data bases compiled exclusively for companies developing electronic messaging through Telecom Canada's iNet 2000 and ENVOY 100 services.

Data bases being developed include industry-specific news and current events, association activities and directories of participating firms, product services and assistance programs. More than 1000 records of information have been created for the various data bases since the Electronic Industry Information Centre's inception. Proposed data bases which are cur-

The Alberta Research Council assisted Intera Technologies Ltd. of Calgary in carrying out a weather modification project in Greece.

Industrial Information carried out close to 1,400 online searches for our technology advisors and industrial clients.

rently under consideration by the Electronic Industry Information Centre include an indexed list of new tenders, employment opportunities and financing.

Information Geology

Information Geology has continued to experience steady growth in the number of inquiries for information, now averaging 600 annually, an increase of 150 percent from three years ago. In addition to managing GEODIAL, the provincial geological data base, Information Geology manages geological assessment reports, records of mineral drilling in Alberta and economic mineral files. Information Geology contributes information to the national bibliographic data base, under a data transfer system between GEODIAL and GEOSCAN, the national data base.

Alberta Waste Materials Exchange

The Alberta Waste Materials Exchange (AWME) was established in 1984 as a project of the Alberta Research Council with funding from Alberta Environment. It operates in conjunction with the Canadian Waste Materials Exchange (CWME) as an information clearinghouse designed to put potential users of waste materials in contact with waste producers. A company having unusable material which still has potential value, may list the material with the Exchange. Information submitted is published in a bimonthly bulletin and mailed to other industries which may be able to utilize the available materials. In 1986, 285 companies listed materials with the Exchange and as a result, several successful exchanges were made. One company has projected increased revenues of $300,000 as a result of the sale of an industrial by-product to a U.S. company.

AOSTRA Library and Information Services

The AOSTRA Library and Information Services (ALIS), formerly the Alberta Oil Sands Information Centre, is totally funded by the Alberta Oil Sands Technology and Research Authority. It is the central source of all published information on oil sands and heavy oil as well as selected publications on enhanced recovery processes. Four confidential data bases, the AOSTRA/Alberta Research Council Access Program, the AOSTRA University Research Program, the AOSTRA/Industry Field Pilots and AOSTRA Mining, Extraction and Upgrading Program and the reports pertaining thereto are also maintained by the information centre.

Alberta Research Council information specialists carry out online searches and provide voice/data conferencing to industry and government clients.

New Technologies

Computing and Automation Technologies

The Advanced Technologies Program covers research and development in information and automation technologies, directed towards the upgrading of existing Alberta firms and the development of new ones. This program serves the province from the Calgary regional office.

Information technologies research is directed towards development and application of artificial intelligence technologies for industrial use. As examples, a prototype simulation system, based upon temporal reasoning techniques, has been implemented for an Alberta firm to resolve mining production and transportation problems. A prototype image recognition system also has been developed in association with other artificial intelligence subdisciplines of planning, knowledge representation, and temporal reasoning. This initiative deals with the specification and planning of events involving time.

Activities in automation technologies are mainly directed towards the manufacturing sector and emerging high-technology industries in the province. Laboratory facilities continue to be developed for use in tests required by both research and industrial applications projects. The laboratory facilities include two robots (PUMA, Adept), computer work stations, a microprocessor development system, and support equipment for mechanical and electronic prototype systems. Simulation software is also available and being used by researchers to define the design of robot-based working environments. A new system also is being designed to improve electrical signals from sensors for control systems in automated manufacturing.

Feasibility studies and investigations of expert systems applications for industry have been done in the areas of well test analyses, reservoir engineering processes and economic analyses. Proposals and fee-for-service contracts have been developed in association with a number of Alberta firms which require sensors, microprocessors, control systems and robotics. One example pertains to the use of sensing devices to control valve grinding operations.

Research staff work with Alberta firms as they explore the utilization of new technologies. Seminars, educational discussions and workshops have been encouraged by industries, both large and small, and have been undertaken to transfer knowledge of scientists and engineers at the Alberta Research Council to their counterparts in industry.

To gain specific information on needs of Alberta manufacturers, an industrial automation survey was initiated. Jointly funded by the Alberta Research Council and Alberta Technology, Research and Telecommunications, the survey is intended to identify impediments to adopting modern product development and manufacturing methods in Alberta.

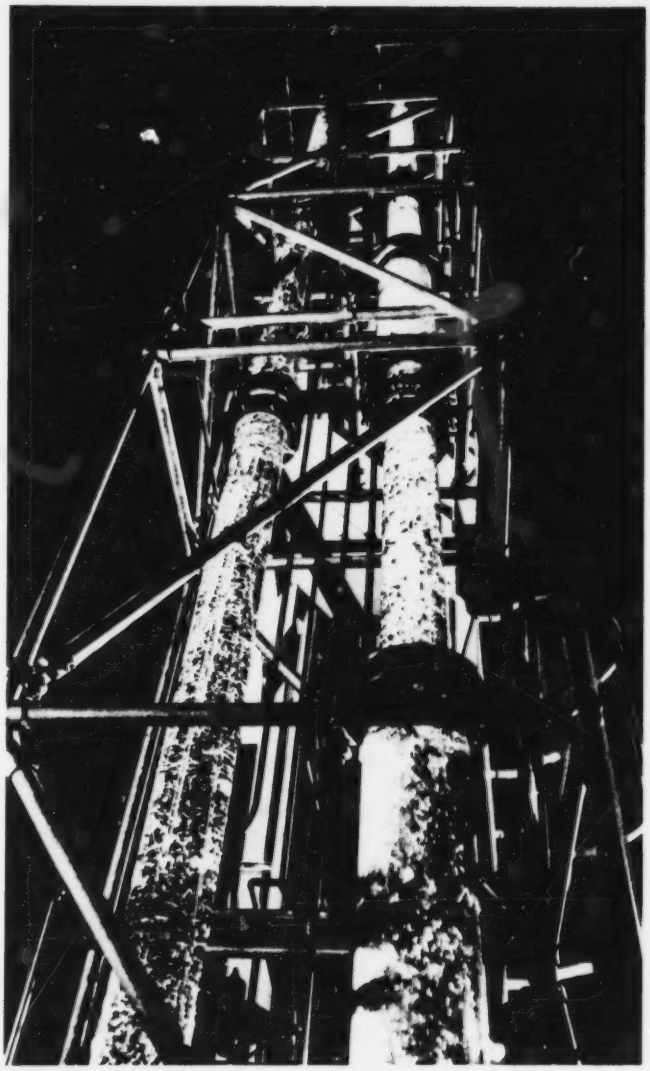
Joint Research Ventures

The joint research venture program has become an effective mechanism for transfer of new technologies to Alberta's industries. Intera Technologies Ltd. and Nortech Surveys (Canada) Inc. are currently marketing

The joint research venture program has become an effective mechanism for transfer of new technologies to Alberta's industries.

Dr. Robert R. Stewart of Veritas Software Ltd., Calgary, and Dr. Stephen Chiu, Alberta Research Council, look at new seismic technology developed for the geophysical industry under one of the Research Council's joint research ventures.

The 300-litre, all-glass, tower-loop fermentor developed in the Biotechnology Pilot Plant under contract with Pegasus Industrial Specialties, Agincourt, Ontario.



Major emphasis in the Biotechnology Program is on providing scale-up and process development assistance to new biotechnology companies and new biotechnological processes.

systems and benefiting from prototype products developed under this program. The Intera Technologies system facilitates the movement of vessels in ice-infested waters, while the Nortech Surveys system provides for precise aircraft positioning, using Global Positioning Satellite technology for accurate topographical mapping.

A joint research venture with Q.C. Data Collectors Ltd. has produced a low-cost vector editing work station. The system takes digital data from general map scanners and separates the features of interest, such as contours, roads and drainage systems. Once the information is embedded within the computer system, various features on general purpose maps can be edited for further analysis and quantitative use. As an example, the low-cost vector editing system developed with Q.C. Data Collectors is an integral component in using off-the-shelf Geographical Information Systems for land use planning based on commonly available thematic maps.

Joint research ventures within the energy sector are underway with Veritas Software Ltd. and with the D & S Petroleum Consulting Group. The joint research venture with Veritas Software Ltd. has produced a system which facilitates the combination of 3-D Vertical Seismic Profile (VSP) data and the more usual Common Depth Point (CDP) surface data. The joint research venture with D & S, also directed towards exploration, has produced a simple prototype computerized well log analysis system based upon artificial intelligence (expert system) technologies.

A joint research venture with Computer Based Training Systems Ltd. has been initiated for the application of expert systems technologies in education. This project incorporates the expertise of curriculum designers, educational diagnosticians and other educational experts. It is directed towards the development of an "expert" computer managed learning system for specialized curriculum development.

Biotechnology

The Biotechnology Program, in its third year of operation, has the long-term goal of promoting the development of a biotechnology industry in Alberta. Major emphasis is on providing scale-up and process development assistance to new biotechnology companies and new biotechnological processes being developed by more established companies.

The Biotechnology Pilot Plant completed its first year of operation during 1986 and can provide production and processing scale-up from the laboratory scale to 1500 litres. A 7500-litre fermentor was installed by the end of the year in another step toward a full range of facilities. The Pilot Plant is designed to provide scale-up in multiples of 10, and at each stage to provide fermentation, separation, fractionation drying and packaging of the product. Analytical capability also is provided.

A new design for a 300-litre, all-glass, tower-loop fermentor was developed under contract with Pegasus Industrial Specialties, Agincourt, Ontario, with partial support from the National Research Council's PILP program. This fermentation vessel and

its associated equipment was assembled and tested, relevant operating parameters measured, operational procedures developed, and performance evaluations were made. The tower-loop fermentor is designed for the cultivation of plant cell cultures and other cultures especially sensitive to the stresses of mixing.

In a project with ens Biologicals, Inc., Toronto, and International Genetic Sciences Partnership, Inc., Israel, the cultivation of a plant cell culture for the production of a natural food coloring was scaled up to 1500 litres, and a process for extraction and purification of the product was developed. On behalf of Cheladyn Enterprises Ltd. of Edmonton, preliminary microbiological research was completed on a process to develop a health food product.

New projects, beginning towards the end of the year, include the development and scale-up of a process to produce entomogenous nematodes for BIOSIS, Inc., Palo Alto, California. The goal of this three-year program is a product which will provide a natural alternative to synthetic chemical pesticides now in widespread use.

An agreement with Vetrepharm, Inc., London, Ontario, will result in the development and scale-up of the production of new veterinary products specifically designed to deal with animal health problems found in Canada.

A grant from Alberta Agriculture's Farming for the Future program supported the development of a small-scale process for the production of alfalfa embryos in fermentation vessels. Alfalfa embryos produced by this process could be encapsulated to produce artificial alfalfa seeds of genetic uniformity with better field performance than naturally-produced seed.

Additional support from Farming for the Future allowed the progression of the Research Council's long-term *Rhizobium* innoculant program from the laboratory to the pilot plant and the development of an efficient small-scale process for the production of *Rhizobium* innoculants.

Plant cell culture projects have been performed with Alberta Research Council funds and partial support from both the National Research Council, Saskatoon, and Plainsman Manufacturing, Inc., Edmonton.

The Electronics Test Centre is being utilized effectively by western industry and is also assisting the Government of Alberta and other groups in the province in attracting new high technology business into the province.

Electronics Test Centre

In order to encourage and stimulate the electronics, telecommunications and high technology industry in Alberta, the Government of Alberta has established the Electronics Test Centre under the auspices of the Alberta Research Council. The development of the Test Centre has been funded through a special Alberta Heritage Savings Trust Fund capital grant, with provision for operational deficits to be funded by the Government of Alberta, general revenue fund, to a total of $10.6 million. The Electronics Test Centre provides evaluation, testing and consultative services to electronics and telecommunications manufacturers to meet Canadian and international requirements.

In its first operational year the Electronics Test Centre has met the primary objective for service to, and penetration of, the electronics industry of Alberta. In 1986, the Test Centre had in hand 170 projects from 111 Alberta companies. This represents 64 percent of the workload and virtually all of the electronic testing service business within Alberta. Significant market penetration in the other western provinces has also been achieved, with British Columbia representing 18 percent and Manitoba and Saskatchewan representing six percent of the Electronics Test Centre's projects.

Results show that it is being utilized effectively by western industry and is also assisting the Government of Alberta and other groups in the province in attracting new high technology business into the province. For one such proposed new investment the Test Centre participated in the business plan preparation. This plan is currently under review by the Government of Alberta.

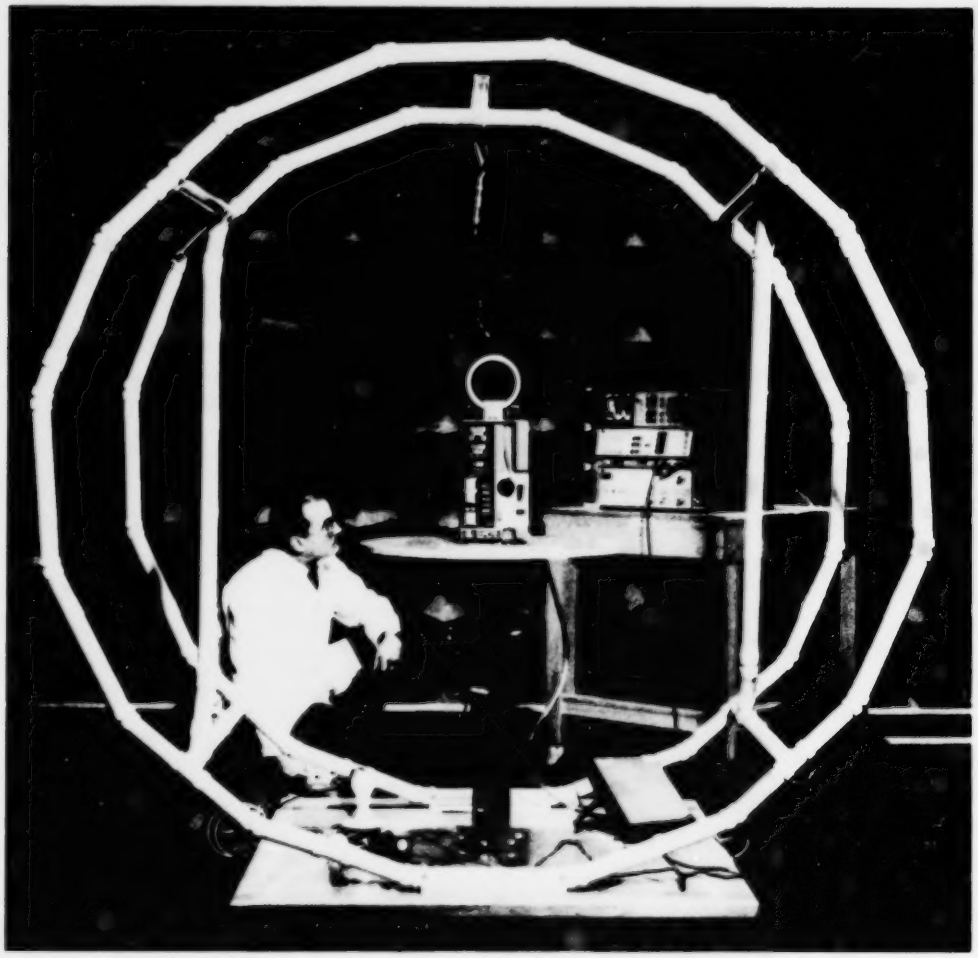
To assist customers and enhance its reputation as a world class centre of excellence, the Electronics Test Centre has followed a program of recognition and accreditation by standards and regulatory authorities world wide. To date, accreditation or recognition has been received, or is in the final stages of negotiation, from: Department of Communications, Standards Council of Canada, Department of National Defence, Canadian Standards Association, Federal Communications Commission (U.S.A.), Japanese Metals and Machinery Inspection Institute.

Staff are active in the work of several national and international standards bodies and committees. New marketing initiatives are being undertaken by the Electronics Test Centre to broaden the range of services offered to customers and the geographical areas served.

New services being offered, or under consideration, include calibration of test equipment, the testing

and evaluation of electromedical devices and the qualification of products purchased by clients. The Electronics Test Centre is expanding its served geographical areas in international clients and also is soliciting Department of Defence business, with two test projects under way for western Canadian subcontractors to the Canadian Frigate Program.

The Electronics Test Centre is expanding its served geographical areas.



Electrical engineer Grant Zackowski with the Helmholtz Coil built at the Electronics Test Centre. The apparatus is designed to produce an homogenous magnetic field to determine the electromagnetic susceptibility of selected medical devices and will be used in a study for Health and Welfare Canada.

Patents and Publications

Valid Patents

Alkali recycling process for recovery of heavy oils and bitumens
Kessick, M.A.

Apparatus for progressively removing layers or overburden from an inclined side of a cut
Owen, H.D. and T. Smith

Arc welding
Roen, R.A.

Article passing rotary seal
Jensen, E.J. and L.M. White

Beneficiation process for oxidized iron ore
Bertram, E.F. and P. Harris

By-pass system for transporting pipelined solid bodies around pumps
Berkowitz, N., R.A. Brown, E.J. Jensen and C. De Zeeuw

Coal liquefaction process with oil sand bitumen derived solvent
Moschopedis, S.E.

Combination solvent injection-electric current application method for establishing fluid communication through heavy oil formation
Sacuta, A.

Composition of matter convertible to stable metallic form by hydrogen reduction
Gravenor, C.P.

Desulfurization of fluid coke
George, Z.M.

Enhanced oil recovery using electrical means
Sacuta, A.

Extraction of oil from bituminous sands
Clark, K.A.

Formation of coke from heavy crude oils in the presence of calcium carbonate
Kessick, M.A., Z.M. George and L.G. Schneider

Hydrodesulfurization of coke
George, Z.M.

Hydrogen reduction of ferrous chloride
Rigg, T. and C.P. Gravenor

Hydrometallurgical method for the direct extraction of metals
Gravenor, C.P., G.J. Govett and T. Rigg

Improved hydrometallurgical iron process
Gravenor, C.P., G.J. Govett and T. Rigg

In-situ formation of oil-in-water emulsion from bituminous oil
Kessick, M.A., C.E. St. Denis and D.J. Currie

Iron powder and iron sponge produced from ferrous chloride and method thereof
Gravenor, C.P.

Lime addition to heavy crude oils prior to coking
Kessick, M.A., Z.M. George and L.G. Schneider

Method and apparatus for direction of solid bodies in pipeline transportation
Round, G.F.

Method and apparatus for pumping mixtures
Kruyer, J. and G.F. Round

Method and apparatus for transporting material in a pipeline
Hodgson, G.W., A.A. Roehl and M.E. Charles

Method and apparatus for transporting package material in a pipeline
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Method of feeding ruminants N-Glucosyl-N'-Hydroxymenthylurea
Elofson, R.M., L.P. Milligan, J. Wohllebe and M. Worsley

Method of preparation of coal for safe transport and storage
Berkowitz, N. and J.G. Speight

Method of transporting a substance along a pipeline
Kruyer, J.

Method of transporting oil and natural gas along a pipeline
Jensen, E.J., R.A.S. Brown and E.J. Wiggins

Pipeline transportation of suspensions of subdivided solids
Berkowitz, N. and C. Moreland

Pipeline transportation of heavy crude oil
Kessick, M.A. and C.E. St. Denis

Process for recovering bitumen from tar sand
Kruyer, J.

Process for selective extraction of metal from aqueous chloride solutions containing two or more metal chlorides
Gravenor, C.P. and G.J. Govett

Process for the preparation of trans-3-formylbut-2-enenitrile
Chen, S.C. and J.M. MacTaggart

Production of metallurgical coke from oxidized caking coal
Isnasiak, B.

Regeneration process for poisoned claus alumina catalyst
George, Z.M.

Regeneration process for poisoned claus alumina catalyst, including NaOH activation
George, Z.M.

Ruminant feed supplement and process for producing same
Diner, U. and R.M. Elofson

Seedling container
Creighton, S.M., D.L. Mitchell and W.C. Kay

Separation of coal-oil suspensions
Hodgson, G.W., F.G. Round and J. Kruyer

Transition metal catalyst
Gaddalah, F. and R.M. Elofson

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Kessick, M.A.

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Petrology and geochemistry of the Canadian Shield of northeastern Alberta
Goff, S.P., J.D. Godfrey and J.G. Holland
Bulletin 51 ($10.00)

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Sprenke, K.F., C.S. Wavra and J.D. Godfrey
Bulletin 52 ($10.00)

Surficial geology of the Calgary urban area
S.R. Moran
Bulletin 53 ($30.00)

Geology of the basement beneath the Athabasca Basin in Alberta
Wilson, J.A.
Bulletin 55 ($16.00)

Reports

Geology of the Fitzgerald, Tulip-Mercredi-Charles Lakes district, Alberta
Godfrey, J.D. and C.W. Langenberg
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Barge, B.L., B. Kochtubajda, M. English, J. Renick and R. Humphries
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Financial statements

ALBERTA LEGISLATURE
OFFICE OF THE AUDITOR GENERAL

Auditor's Report

To the Board of Directors of
the Alberta Research Council

I have examined the balance sheet of the Alberta Research Council as at March 31, 1986 and the statement of revenue, expenditure and equity for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances, except as explained in the following paragraph.

As disclosed in Note 4 to the financial statements, the Council has entered into research contracts which specify that the Council does not receive title to fixed assets purchased until completion of the contract or at the discretion of the sponsor. Since the Council did not identify those fixed assets to which it may not have title, I was unable to determine if any adjustment might be required to the balance sheet to adjust fixed assets and fixed assets equity to reflect ownership of the assets.

In my opinion, except for the effect of adjustments, if any, which I might have determined to be necessary had I been able to identify assets to which the Council may not have title as described in the preceding paragraph, these financial statements present fairly the financial position of the Council as at March 31, 1986 and the results of its operations for the year then ended in accordance with the disclosed basis of accounting, considered appropriate in the circumstances, as described in Note 2 to the financial statements applied on a basis consistent with that of the preceding year.

Donald D. Salmon

C.A.
Auditor General

Edmonton, Alberta
August 15, 1986

Alberta Research Council
Balance Sheet
as at March 31, 1986
(thousands of dollars)

Assets	1986	1985
Current:		
Cash	$10,992	$14,181
Accounts receivable	5,042	2,344
Accrued income receivable	2,081	2,774
Prepaid expenses	25	539
Advances to joint ventures	624	487
	18,764	20,325
Non-current:		
Investment in limited partnership (Note 3)	200	-
Fixed:		
Equipment (Note 4)	37,014	27,208
	55,978	47,533
Trust Fund:		
Cash	180	178
	$56,158	$47,711
Liabilities and Equity		
Current:		
Accounts payable	$ 3,202	$ 3,902
Unearned contract revenue	938	2,954
Promissory note payable (Note 3)	100	-
	4,240	6,856
Non-current:		
Unearned contract revenue	1,100	-
Promissory note payable (Note 3)	100	-
	1,200	-
Equity:		
Fixed assets	37,014	27,051
Operating	6,502	7,328
Special purpose, Schedule 1	5,486	6,298
Capital reserve	1,536	-
	50,538	40,677
	55,978	47,533
Trust Fund:		
Trust liability	180	178
	$56,158	$47,711

The accompanying notes are part of these financial statements.

Alberta Research Council
Statement of Revenue, Expenditure and Equity
for the year ended March 31, 1986
(thousands of dollars)

		Special Purpose	Total	
Revenue	**Operating**	**(Schedule I)**	**1986**	1985
Grants from Province of Alberta:				
General Revenue Fund	$18,727	$7,482	$26,209	$22,924
Alberta Heritage Savings Trust Fund	-	1,385	1,385	4,225
	18,727	8,867	27,594	27,149
Contract revenue	21,179	72	21,251	19,994
	39,906	8,939	48,845	47,143
Expenditure				
Natural Resources Division	12,580	-	12,580	12,753
Energy Resources Division	11,229	-	11,229	11,083
Applied Sciences Division	6,965	-	6,965	5,284
Industrial and Engineering Research Division	3,081	703	3,784	2,569
Finance and Administration Division	4,163	-	4,163	4,592
Executive offices	1,178	-	1,178	1,146
Millwoods/Devon fitting up	-	2,760	2,760	831
Electronics Test Centre	-	6,092	6,092	2,080
Office of Science and Technology	-	196	196	149
	39,196	9,751	48,947	40,487
Excess (deficiency) of revenue over expenditure for the year	710	(812)	(102)	6,656
Equity at beginning of year	7,328	6,298	13,626	6,970
	8,038	5,486	13,524	13,626
Transfer to capital reserve	(1,536)	-	(1,536)	-
Equity at end of year	$ 6,502	$5,486	$11,988	$13,626

Alberta Research Council
Notes to the Financial Statements
March 31, 1986

Note 1 Authority
The Alberta Research Council operates under the authority of the Alberta Research Council Act, Chapter A 35.1, Statutes of Alberta 1981.

Note 2 Summary of Significant Accounting Policies and Reporting Practices
(a) General
These financial statements have been prepared in accordance with generally accepted accounting principles except that no provision for depreciation on fixed assets has been made. Purchases of operating fixed assets are charged to operations in the year and are shown on the balance sheet at original cost or at estimated cost with the offsetting credit to fixed assets equity.

(b) Advances to Joint Ventures
Advances to joint ventures are recorded as assets of the Council. The asset is reduced and a corresponding charge is made to expenditure for the Council's share of joint venture expenses.

(c) Patents
Expenditures for patents owned by the Council as a result of research activity are not capitalized due to the intangible nature of assets that may accrue to the Council.

(d) Investment
The Council is a minority shareholder of International Permeation Inc. The equity allocated to Council was based upon the technological "know-how" acquired by International Permeation Inc. from a former company to which Council provided research and technological expertise and was the majority shareholder.

The Council's equity in the company is not reflected in these financial statements due to the intangible nature of the benefits which may accrue to the Council.

(e) Investment in Limited Partnership
The investment in the limited partnership is expensed in the year that installment payments called for in the limited partnership agreement are paid.

(f) Contract Revenue Recognition
Contract revenue is recognized as costs are incurred, up to the contract maximum and in accordance with contracted cost sharing ratios. In accordance with generally accepted accounting principles Council makes full provision for all known or estimated losses on uncompleted contracts as soon as they can reasonably be estimated. Accordingly, revenue is deferred to future years and matched against costs incurred to complete the project.

(g) Special Purpose Equity
Special purpose equity is to be used only for future expenditures related to those activities listed on Schedule I.

(h) Capital Reserve
The Alberta Research Council has established a Capital Reserve to provide for the future acquisition of capital assets.

(i) Trust Liability
Trust funds are contributions received from other government departments under research agency agreements which specify the Council administer the contributions and provide accounting services.

(j) Changes in Financial Position
A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 Investment in Limited Partnership

The Council has purchased one limited partnership unit in Spurt Investment Fund I, a venture capital fund designed solely to make equity investments in seed and early stage technology enterprises. The partnership unit which cost $300,000, was acquired with a payment of $100,000 and a non-interest bearing promissory note requiring payments of $100,000 on each of October 27, 1986 and 1987.

As it is uncertain if any benefits will accrue to the Council, the investment is being written off as payments are made. The amount of the investment is summarized as follows:

Original cost	$300,000
Less: Amount written off	100,000
Book value	$200,000

Note 4 Fixed Assets

Fixed assets purchased subsequent to April 1, 1981 have been valued at cost. Those purchased prior to April 1, 1981 have been valued at estimated cost by the Council.

	1986	1985
Balance at beginning of year	$27,208,354	$22,978,784
Additions at cost	10,176,796	4,350,396
	37,385,150	27,329,180
Disposals at cost	370,667	120,826
Balance at end of year	$37,014,483	$27,208,354

Included in fixed assets are certain fixed assets purchased as a result of research contracts which specify that the Council does not receive title to the fixed assets purchased until completion of the contract or at the discretion of the sponsor.

Note 5 Contingent Liabilities

The Council is a defendent in a number of legal proceedings. Claims against the Council in these proceedings, which have not been reflected in the accounts, amounted to $1,016,000 as at March 31, 1986. While the ultimate outcome of these proceedings cannot be predicted at this time, it is the opinion of management that the disposition of these cases will have a minor effect on the financial position of the Council.

Note 6 Occupancy and Office Furniture Expenditure

Occupancy and office furniture have been provided by the Province of Alberta at no cost and are not reflected in these financial statements.

Note 7 Comparative Figures

The 1985 figures have been reclassified where necessary to conform to 1986 presentation.

Note 8 Approval of Financial Statements

These financial statements were reviewed by management and recommended to the Board for approval.

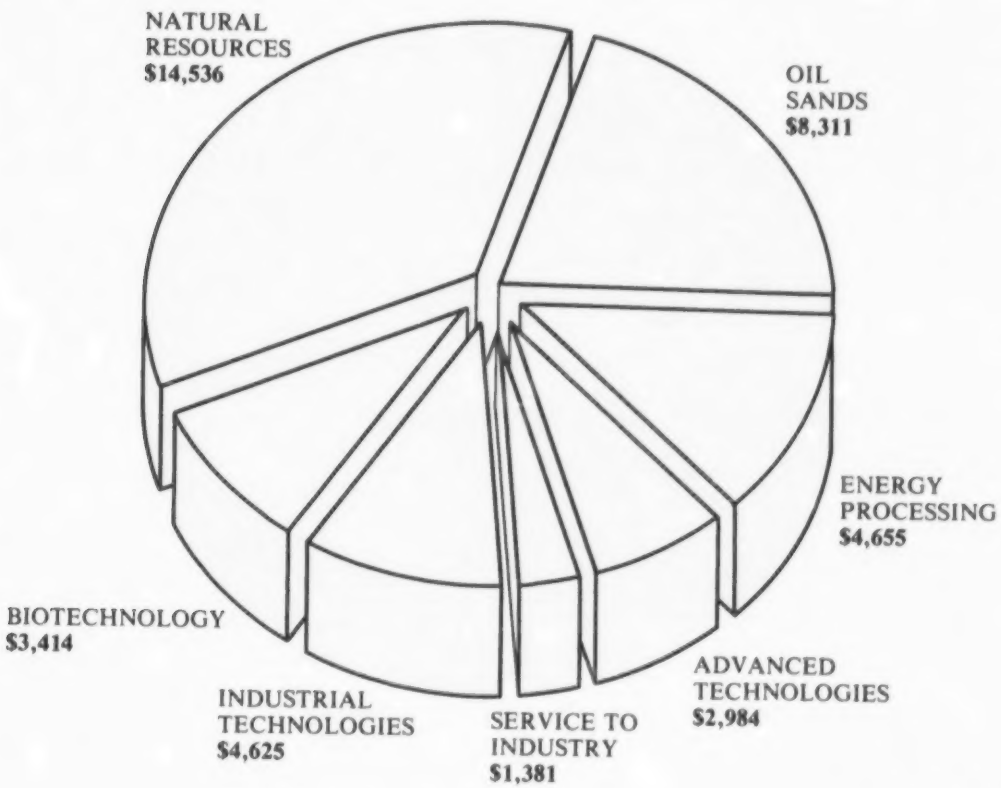
Alberta Research Council
Schedule of Special Purpose Revenue, Expenditure and Equity
for the year ended March 31, 1986

Schedule 1

	Electronics Test Centre	Office of Science & Technology	Subtotal	Joint Research Venture Initiatives	Millwoods/ Devon Fitting Up	Electronic Industry Information Centre	Bio-technology Toll Facility	Subtotal	Total 1986	Total 1985
Revenue										
Grants from Province of Alberta:										
General Revenue Fund	$2,364,000	$176,000	$2,540,000	$2,019,000	$2,300,000	$623,000	-	$4,942,000	$7,482,000	$4,197,000
Alberta Heritage Savings Trust Fund	1,385,000	-	1,385,000	-	-	-	-	-	1,385,000	4,225,000
Contract revenue	68,340	3,750	72,090	-	-	-	-	-	72,090	15,000
	3,817,340	179,750	3,997,090	2,019,000	2,300,000	623,000	-	4,942,000	8,939,090	8,437,000
Expenditure										
Manpower	535,462	108,648	644,110	-	-	7,603	3,060	10,663	654,773	215,280
Supplies and services	1,547,348	87,614	1,634,962	381,312	-	43,171	5,426	429,909	2,064,871	1,318,360
Fixed assets	3,917,883	-	3,917,883	-	2,759,684	-	262,624	3,022,308	6,940,191	1,496,664
Overhead	91,736	-	91,736	-	-	-	-	-	91,736	29,102
	6,092,429	196,262	6,288,691	381,312	2,759,684	50,774	271,110	3,462,880	9,751,571	3,059,406
Transfer (to) from	-	-	-	271,110	-	-	(271,110)	-	-	-
	6,092,429	196,262	6,288,691	652,422	2,759,684	50,774	-	3,462,880	9,751,571	3,059,406
Excess (deficiency) of revenue over expenditure for the year	(2,275,089)	(16,512)	(2,291,601)	1,366,578	(459,684)	572,226	-	1,479,120	(812,481)	5,377,594
Balance at beginning of year	3,606,364	197,834	3,804,198	-	2,494,160	-	-	2,494,160	6,298,358	920,764
Balance at end of year	$1,331,275	$181,322	$1,512,597	$1,366,578	$2,034,476	$572,226	-	$3,973,280	$5,485,877	$6,298,358

As instructed by the Treasury Department, Council temporarily reallocated funds from the Joint Research Venture Initiatives account to cover expenditures incurred in the startup construction phase of the Biotechnology Toll Facility. The Joint Research Venture Initiatives account will be reimbursed in 1986/87.

Distribution of income (grant and contract) to Alberta Research Council research programs (000's)



Total income (grant and contract)
$39,906,000

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*1 December 1986

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Secretarial Staff: J.E. MOORE.

Administrative Services

Director: Vacant.

Materiel Management

Manager: C.G. CAMERON.
Purchasing Agent: H. KAY.
Support Staff: D. BRACKETT; L.L. CLENCHY; V.E.G. CRAIGE; R.K. ONUCZKO; R.P. PARSONS; B.E. ROBINSON; G.D. ROWBOTTOM; H.M. SCHEIDEMAN; B.G. SEMOTIUK; C.A. STACHNIAK; A.C. THIESSEN; J.E. TRASK; D.L. WASYLYK; M.E. ZAIFFDEEN.

Records Management

Manager: Vacant.
Support Staff: V.C. ABAT, B.Sc. (Northern Luzon State); A. AICHHOLZ; J.C. CHECHOLIK; M. WEEKS.

Facilities Management

Manager: W.C. FORD.
Facilities Coordinator: F.K. KAMPRATH.
Support Staff: B.L. BISSELL, B.A. (Alberta); S.L. IWASKOW; B.G. LEESON; M.E. OSBORNE; L.M. STRADER.

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Technical Staff: D.L. PELZMAN.
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